

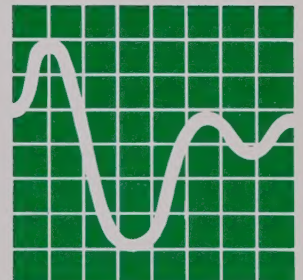
INSTRUCTION MANUAL

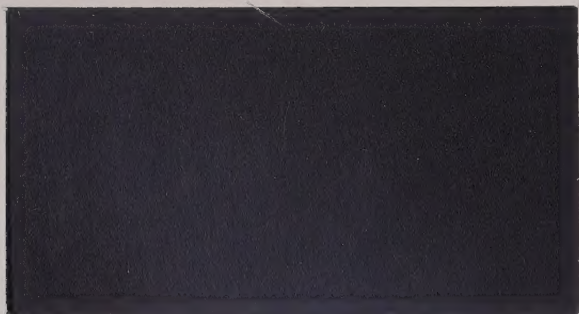
QRB SERIES

DC POWER SUPPLIES

40-.75

SORENSEN POWER SUPPLIES





INSTRUCTION MANUAL

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DC POWER SUPPLIES

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SORENSEN, A Unit of Raytheon Company, Richards Ave., South Norwalk, Conn.

A14 - 5308

7/64

GENERAL INFORMATION

WARRANTY

Raytheon warrants all parts of equipment of its manufacture, except special purpose tubes and semi-conductor devices which carry their own manufacturer's warranty, to be free from defects caused by faulty material or poor workmanship. Raytheon warrants its products to conform to applicable commercial or military specifications when confirmed on the Order Acknowledgment form to be free from defects caused by faulty material or poor workmanship. Raytheon's obligation is limited under the warranty to repair or replacement of products in kind, or at its sole option to issuance of a credit of original purchase price. Returns must be accompanied by a Raytheon Return Authorization form and conform to standard conditions for adjustment. The aforesaid warranty shall expire twelve (12) months following the last day of the month of shipment from Raytheon's plant. The foregoing states the entire warranty extended by Raytheon. No other warranty, express or implied, is made and, specifically, Raytheon makes no warranty of merchantability or fitness for any purpose. In no case shall Raytheon be liable for any special or consequential damages. Authorization must be obtained prior to return of defective items.

RAYTHEON COMPANY, Sorensen Operation

SERVICE INFORMATION

Questions concerned with the operation, repair, or servicing of this instrument should be directed to the nearest Sorensen representative (a list is included with this manual) or to the Service Department, Raytheon Company, Sorensen Operation, Richards Avenue, South Norwalk, Connecticut. *Include the model number and serial number, in any correspondence concerning this instrument.*

SHIPPING DAMAGE

It is possible for equipment to be damaged in shipment. Therefore, it is imperative that the instrument be tested and inspected as soon as it is received. If the instrument shows signs of damage, follow the instructions on the DAMAGE and/or Loss in Shipment form enclosed with the unit and notify the carrier immediately. The carrier's claim agent will then prepare a report of damage and, after you have forwarded this to the Sorensen Service Department, you will be advised as to the action necessary to have the instrument repaired or replaced.

RETURNS TO THE FACTORY

Should it be necessary to return an instrument to the factory for repair, please contact the Sorensen Service Department for authorization to make shipment.

RAYTHEON COMPANY WILL ASSUME NO RESPONSIBILITY FOR MATERIAL RETURNED WITHOUT PRIOR AUTHORIZATION.

II. SPECIFICATIONS

	QRB 15-2	QRB 20-1.5	QRB 30-1	QRB 40-.75	QRB 20-4	QRB 40-2
Output: Volts DC	0-15v	0-20v	0-30v	0-40v	0-20v	0-40v
Current	0-2A	0-1.5A	0-1A	0-.75A	0-4A	0-2A
Voltage Regulation		$\pm(0.01\% + 1\text{MV})$ Line and Load Combined				
Ripple @ 60 cps. RMS	200 μ V	200 μ V	150 μ V	150 μ V	200 μ V	150 μ V
Current Regulation		$\pm 0.15\%$ Line and Load Combined				
Ripple — Current RMS	50 μ A	50 μ A	10 μ A	10 μ A	150 μ A	30 μ A
Output Impedance ¹	0.053 ohms	0.053 ohms	0.029 ohms	0.029 ohms	0.02 ohms	0.2 ohms
Response Time		50 Microseconds				
Current Limiting Range ²	0.25-2.25A	0.2-1.6A	0.1-1.15A	0.1-0.8A	0.5-4.5A	0.25-2.25A
Current Limiting Accuracy	10%	10%	10%	10%	10%	10%
Ambient Temperature		0° to 40°				
Temperature Coefficient		$\pm 0.015\%/^{\circ}\text{C}$ typical				
Resolution	2MV	2MV	3MV	4MV	2MV	4MV
Stability ³		$\pm 0.1\%$ typical				
Input: Volts AC		105 to 125 or 201 to 239 or 210 to 250				
Frequency		50, 60 or 400 cycles				
Current @ 125VAC	0.95A	0.85A	0.85A	0.85A	2.2A	2.2A
@ 239VAC	0.50A	0.445A	0.445A	0.445A	1.15A	1.15A

- Notes: 1. Typical value measured at 1 kilocycle.
 2. Range specified for current limiting is by means of front panel pot adjust. Rear adjustment will permit further reduction of current.
 3. For 24 hours (after 30 minute warmup) with constant load, line and temperature.

MECHANICAL DIMENSIONS

Width	8 $\frac{1}{4}$ "	8 $\frac{1}{4}$ "	8 $\frac{1}{4}$ "	8 $\frac{1}{4}$ "	19"	19"
Height	5 $\frac{1}{8}$ "	5 $\frac{1}{8}$ "	5 $\frac{1}{8}$ "	5 $\frac{1}{8}$ "	5 $\frac{1}{4}$ "	5 $\frac{1}{4}$ "
Depth	9"	9"	9"	9"	12 $\frac{1}{4}$ "	12 $\frac{1}{4}$ "
Rack Height	5 $\frac{1}{4}$ "	5 $\frac{1}{4}$ "	5 $\frac{1}{4}$ "	5 $\frac{1}{4}$ "	5 $\frac{1}{4}$ "	5 $\frac{1}{4}$ "
Weight	10 $\frac{3}{4}$ lbs.	10 $\frac{3}{4}$ lbs.	10 $\frac{3}{4}$ lbs.	10 $\frac{3}{4}$ lbs.	31 lbs.	31 lbs.

SPECIFICATION NOTES

NOTE 1: Input Conversion

This unit is capable of operation at 50, 60 and 400 cps, with accommodations for 115, 220 and 230 volt input power. The unit is shipped for 115V/60 cps input power. To convert transformer T1 to 220/230/60 cps operation refer to figures A and B below. (Remember to change the fuse rating).

NOTE 2: Frequency Range

This unit may be operated over an input range from 50 to 400 cps. however, all specifications are only guaranteed at the nominal input frequency of 60 cps. The ripple voltage will increase slightly as the frequency is varied from 60 cps.

NOTE 3: Response Time

When an abrupt change occurs in the input voltage or output load, an instantaneous change in output voltage occurs. This instantaneous change is quickly suppressed by the regulating action of this unit. Response time is the interval between the instant a transient deviates from a specified amplitude range and the moment it returns and remains within the specified amplitude range. The amplitude range shall be centered about the average of the steady state values that exist immediately before and after the transient.

NOTE 4: Current Limit

Output current limit can be adjusted to a minimum of 20 ma, by adjusting potentiometer R38 on the rear panel. (This will restrict the maximum upper current limit.)

Figure A

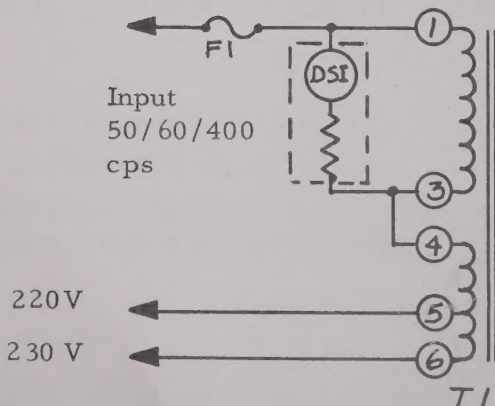
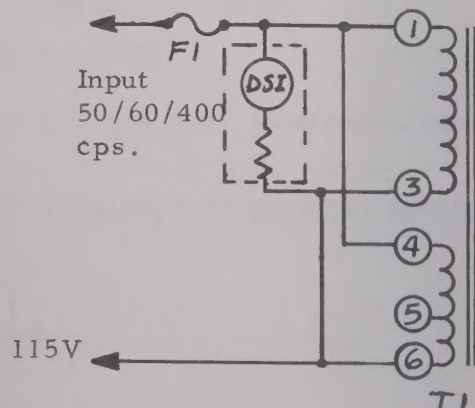


Figure B



III. INSTALLATION AND OPERATION

This instrument when originally purchased may be supplied self-contained for bench top operation or equipped for mounting in a standard 19" relay rack. In the event it is later desired to rack mount a self-contained unit or vice versa, this may be accomplished without difficulty. The user should contact the local representative or the Sorensen Service Department for the necessary parts and instructions.

TERMINALS AND CONTROLS

1. Input Power Connection

The input power is applied by means of a line cord utilizing a 115/230 volt polarized three-prong plug. Since the third prong of this plug is connected to the chassis, connection of the line cord to the appropriate receptacle automatically grounds the equipment. If the user does not have a three prong outlet available, he should use an adapter. The extra wire (colored green) coming out from the adapter, should be solidly grounded to the power line wiring system, preferably soldered. The aforementioned should be carried out for safety reasons.

NOTE: The input line cord and transformer are shipped set up for 105-125 V single phase operation.

2. Output Power Connections.

The DC output is available at the binding posts located on the front panel or at the terminal board located at the rear of the unit. The current limit links are located on the rear terminal board.

Remote sensing the specified load regulation, current regulation, programming parallel and series operation are available at the rear terminals only.

3. Switches.

QRB20-4, QRB40-2 - A toggle switch located on the front panel turns the unit on/off. All other models have a rotary switch which performs three functions:

- a. Turns unit on/off.
- b. Inserts voltmeter into the circuit
- c. Inserts ammeter into the circuit.

4. Pilot Light

Indicates when line power is supplied to the unit.

5. Meters

QRB 80 watt models - DC voltmeter, indicates output voltage
DC ammeter, indicates load currents

QRB 30 watt models - A single meter indicates the output voltage and the load current.

6. Controls

- a. Output adj. - A potentiometer (R4) located on the front panel, adjusts the output voltage to any desired level.
- b. Current Limit - A potentiometer (R39) located on the front panel, protects the load from excessive currents, in the event of a malfunction of the load

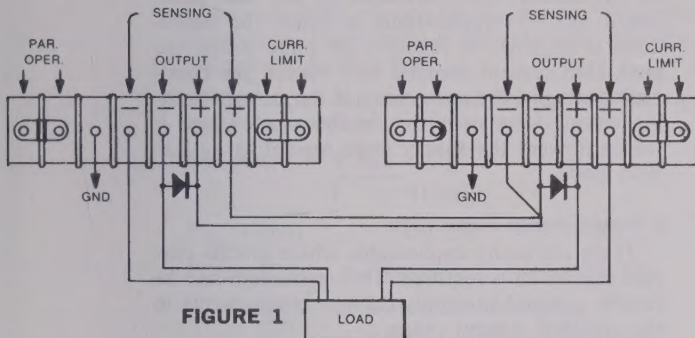
7. Fuses

The input power fuse protects the equipment from damage due to internal or external short circuits when the current limiting circuit is disabled.

APPLICATION NOTES

Series Operation

In order to operate QRB units in series, the rear terminals of the instruments to be operated in series must be interconnected as shown below:



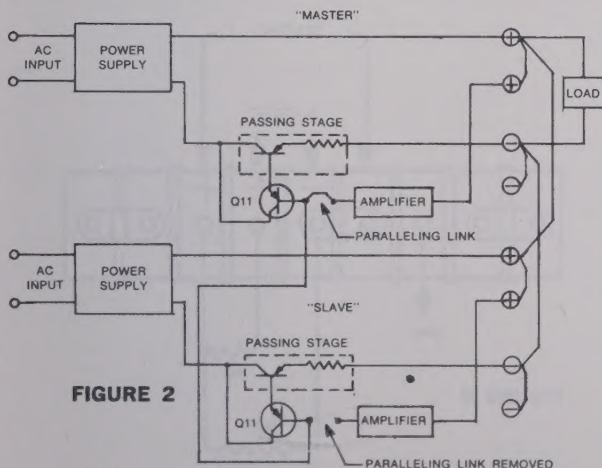
Note 1: The sensing lead must be placed on top of output lead from unit #2 in order to minimize degeneration of regulation due to connection voltage drops.

Note 2: The total voltage in series with the load must not exceed 300 volts due to the breakdown voltage of the mica insulators between the passing transistors and the heat sinks.

The rectifiers are required to provide a current path when the associated instrument is not energized. In this instance, the rectifier protects the output electrolytic capacitor, reducing the capacitor reverse voltage to approximately one volt. The combination, with one instrument de-energized, will continue to function, with load regulation slightly degenerated, since the rectifier's conducting current is outside the sensing string of the operating instrument. Regulation for line variations will be equal to the original specifications.

Parallel Operation

The connections necessary to effect parallel operation are made easily at the instrument's rear terminal board. In the parallel mode of operation, the "Master" instrument's amplifier is used to drive the "Slave" instruments' series passing elements. The "Slave" amplifier is de-energized in this configuration, as shown schematically below:

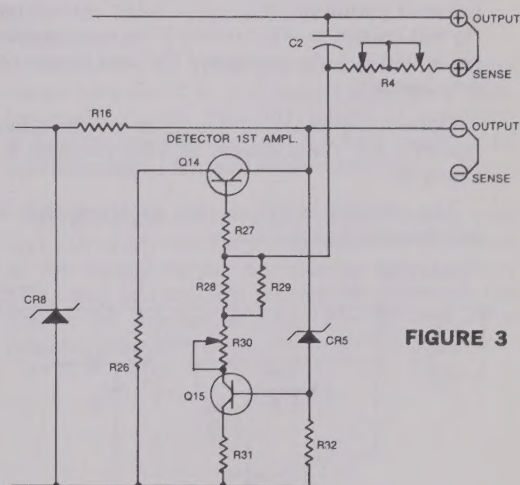


Current division between instruments is dependent upon current division between paralleled transistors. The division of load current between the instruments is therefore dependent upon the current division forced by the use of emitter resistors in each of the parallel pass stages. With this method of paralleling, current differences between instruments at full load are maintained within 10%.

It should be noted that, in this configuration, there will be no output voltage present until the "Master" instrument is energized.

Programming

In normal operation, a constant current of 10 MA flows through the output voltage adjustment potentiometer (R4). This value of current is factory preset by adjusting R30.



If R4 is adjusted to give zero volts output and a preset precision resistor is inserted between the + output and + sensing terminals, in place of the factory installed link, R30 can then be adjusted to give the required output (see procedure below). This establishes a reliable value of 100 ohms per volt as the programming resistance value.

The procedure to be followed to program the instrument is as follows:

1. Determine the value of resistor required to insert between the positive sensing and output terminals on the rear panel. The value is determined by multiplying the 100 ohms per volt figure by the desired output voltage.
2. Rotate R4 to its most counter-clockwise direction (R4=0). Open the link between the positive sensing and output terminals and insert the value determined from (1) above.

In many programming applications, it is required to program within microseconds from one

value of output voltage to another. Normally, this transfer would take a period of time in the order of milliseconds because of the necessity for the A.C. feedthrough capacitor (C2) to discharge to the desired voltage level.

The value of C2 is generally chosen to improve the A.C. gain of the amplifier in order to reduce output ripple. However, if some degeneration in output ripple is permissible, the value of C2 may be lowered to allow for the required fast transfer from one value of preset output voltage to another.

Automatic Voltage/Current Crossover (Current Limiting)

Many applications require that the constant voltage instrument have an automatic crossover feature in order to prevent catastrophic failure of a load when one load element fails in short. All QRB models are equipped with a front panel adjustment permitting the user to select the voltage/-current crossover value at which the current should be limited in order to protect the load from excessive currents.

Current regulation in this mode of operation is typically 5% (see Glossary of Terms — Item 6 — Curve B)

The circuitry which is used to accomplish this requirement is shown below:

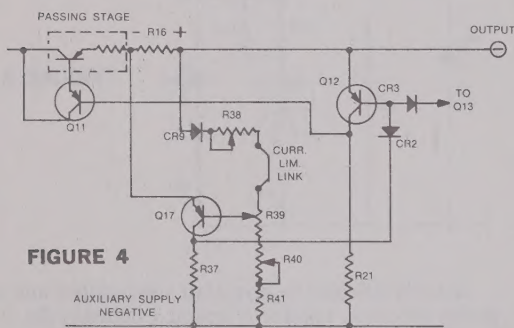


FIGURE 4

When no load current is flowing, transistor Q17 is saturated, diode CR2 is reverse biased and transistor Q11 is driven in accordance with the demands of the collector-emitter voltage drive of transistor Q12. At a predetermined value of load current, based upon the value of R16 and the voltage level of the base of transistor Q17 which is established by the level of R39, transistor Q17 is cut off. Then diode CR2 becomes forward-biased and conducts, raising the base of Q12 towards the negative auxiliary supply, causing Q12 to conduct. As a result, the forward bias of driver transistor Q11 is reduced, increasing the impedance of the series passing stages, which results in decreased output voltage and a limit to the output current that is supplied to the load.

QRB models are supplied with a removable link

on the current limit terminals on the rear panel board, since in applications in which the instrument is required to regulate for pulse loads, the peak load current demand may exceed the maximum rating of the instrument; if the current limiting circuit were operative in this application, it would prevent the supply from regulating against such loads.

Precise Current Regulation

There are many applications where precise current regulation is required. This instrument can be readily adapted to supply current requirements in the specified current range.

Figure 5 is a simplified schematic diagram showing the QRB supply delivering regulated voltage to a stable resistance Rs connected across the output terminals (with X1 and X2 shorted). If an additional load Rx is inserted between points X1 and X2, the current through Rx will be equal to the current through Rs plus whatever current is drawn by the control circuit. Since the control current is small and relatively constant and the voltage is regulated across the fixed resistor Rs, it follows that the current in Rx will be constant in spite of variations in its resistance.

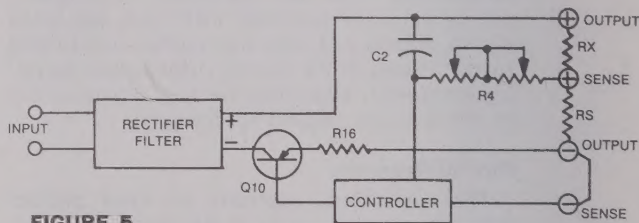


FIGURE 5

To convert this instrument into a constant current regulator, refer to Figure 6 for the proper hookup.

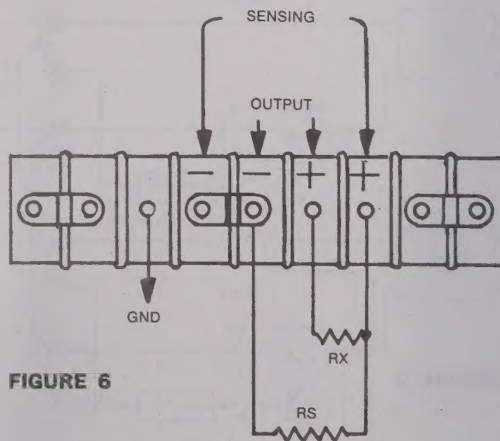


FIGURE 6

To set up the regulator for the required current to be controlled, remove the input power from the instrument. Insert resistor R_s as shown. Resistor R_x will be inserted later.

The actual resistance and wattage of R_s are computed as follows:

$$R_s \text{ (ohms)} = \frac{V \text{ min}}{I_L - 0.01 \text{ amps}}$$

$$P_{R_s} \text{ (watts)} = (V \text{ min}) (I_L - 0.01 \text{ amps})$$

Where R_s^* = Current determining resistor

I_L = Load current amperes

P_{R_s} = Wattage in resistor R_s

$V \text{ min}$ = 3 VDC up to and including 30 volt output units

$V \text{ min}$ = 10 VDC for the 40 volt output units

R_x = Load to be current regulated

* In order to keep current drift at a minimum, it is suggested that the power rating of the resistor be twice the calculated value. In addition, a low temperature coefficient wire should be used for the resistor such as Cupron Alloy 45 or equivalent.

NOW LOAD R_x CAN BE INSERTED

The maximum voltage variation of the load is the difference between $V \text{ min}$ and $V \text{ max}$.

$V \text{ max}$ = maximum output voltage of the unit.

The load resistance variations may be calculated as follows:

$$\text{Max. } R_x \text{ (ohms)} = \frac{V \text{ max}}{I_L \text{ amps}}$$

Min. R_x (ohms) = zero ohms

Remove the input power from the instrument. Remove the shorting link from between + DC and + sense. Insert R_x as shown in Figure #6. Make the final adjustment for the load current by means of the output adjust control (R_4).

To summarize, specified precise current regulation may be maintained provided certain simple requirements are met.

1. The maximum current should not exceed the rating of this instrument.
2. The sum of the voltage drops across R_s and R_x should not exceed the maximum voltage rating of this instrument.

Resolution

Resolution of QRB power supplies is maintained between 2 to 4 millivolts depending upon the model chosen. This high degree of resolution is achieved through the use of a high quality dual potentiometer (fine and coarse adjust)

By designing for a relatively low sensing current (10 MA), relatively large values of resistance in the voltage-output determining potentiometer (R_4) may be used. The greater the resistance, the greater the number of total turns of wire on a potentiometer; therefore, the better the resolution.

IV. PRINCIPLE OF OPERATION

The QRB Nobatron is a regulated DC power supply, employing semi-conductors throughout. The operation of this equipment can best be understood by referring to the block diagram (Figure #7) shown below and to the schematic diagram.

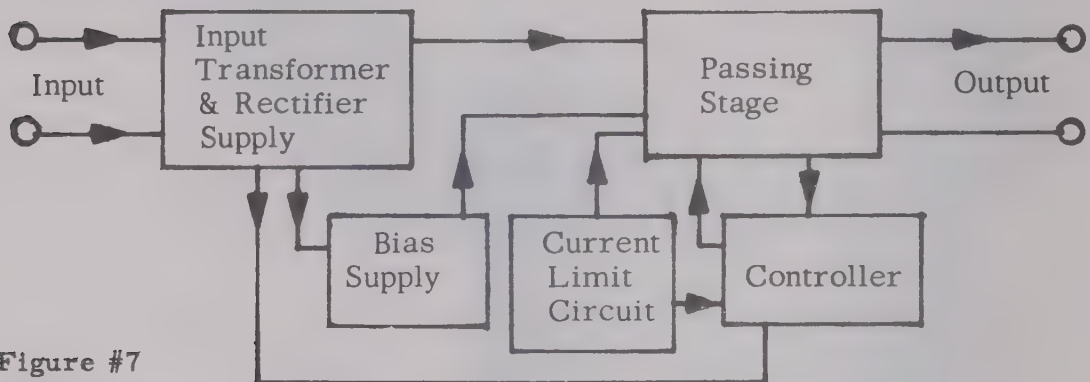


Figure #7

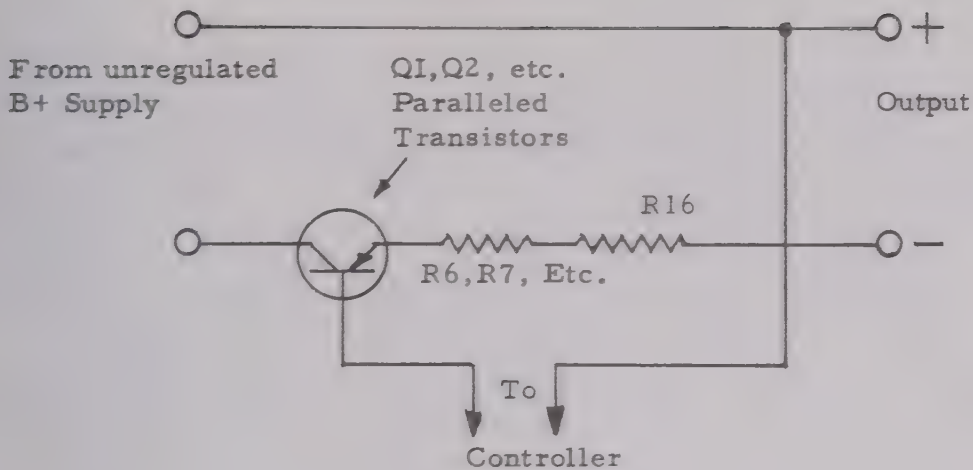
1. Input Power & Rectifier Supply

The main power supply employs bridge or full wave rectification with capacity input filtering. This voltage is fed to the series passing stage and output terminals. The auxiliary supply features full wave rectification with capacity input filter to supply the bias and amplifier circuits.

2. Transistor Series Passing Stage

The main power supply voltage appears across the output terminals, minus the drop across the passing transistors (Q1, Q2, etc.), resistors (R6, 7, etc) and resistor R16. This passing stage can be thought of as a variable impedance. If the output voltage tends to rise, due to a line or load change, the passing transistor impedance increases. The result is additional transistor voltage drop, which maintains the output voltage at the preset value. Conversely, if the output voltage falls, the impedance of the transistors decrease and additional voltage would be supplied to the output terminals, thus returning the output voltage to its original level. R6, R7, etc. are emitter balancing resistors, which insure the equal distribution of the load current through each transistor. Refer to Figure #8.

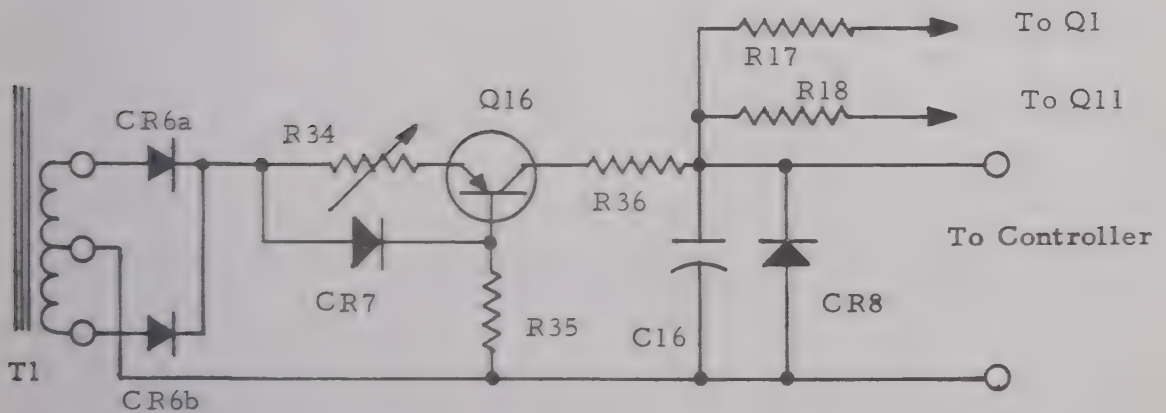
Figure # 8



3. Bias Supply

The aux. supply features full-wave rectification (CR6, Figure 9) with capacitor input filtering (C9) which feeds the bias circuit and the control amplifier circuit. The bias voltage is obtained from resistor R36. However, this voltage could vary due to line or load changes. To stabilize the bias voltage, transistor Q16, R34, R35 and diode CR7 are added. These components are connected as shown in Figure # 9 to produce a constant current regulator. Maintaining a constant current through R36 will establish a constant "bias" voltage across resistor R36. Variation in auxiliary supply voltage because of line and load changes are then dropped across Q16. Resistor R17 supplies the appropriate bias voltage to this passing transistor and R18 supplies bias voltage to transistor driver-amplifier Q11.

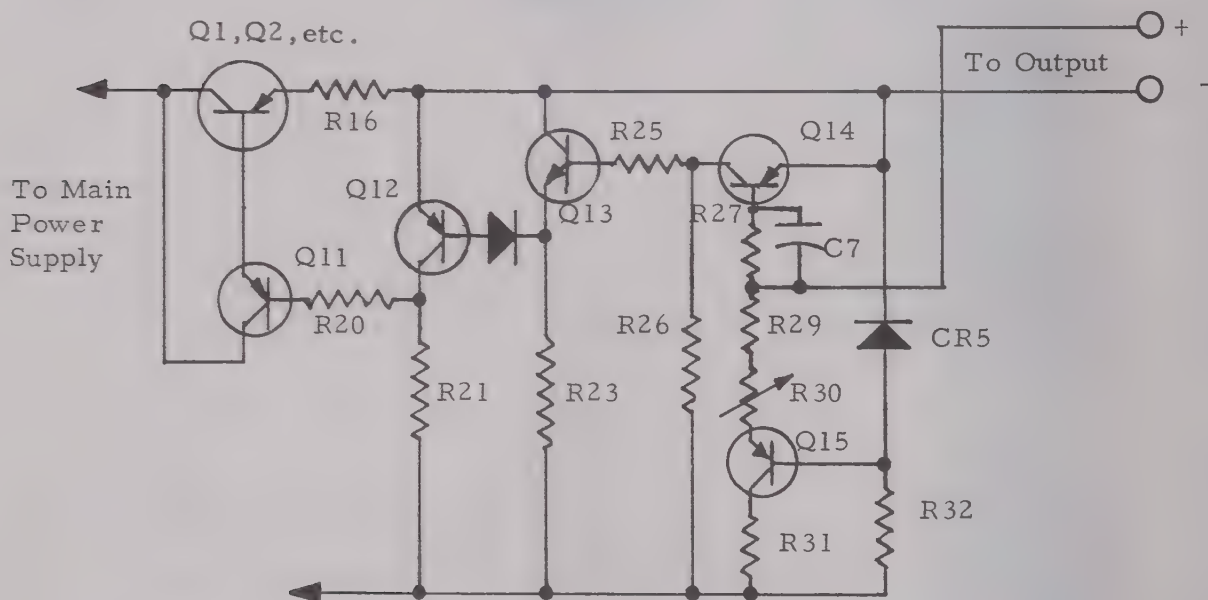
Figure # 9



4. Controller (Sensing Circuit and Amplifier)

The sensing circuit employs a constant current reference and resistor network consisting of Q15, CR5, R4, R28, R29, R30, R31 and R32. Transistors Q11, Q12, Q13 and Q14 and the associated components amplify the error signal, which controls the impedance of the passing transistors. The theory of operation is as follows: (Refer to Figure # 10). If the output voltage tends to rise, due to a line or load change, this voltage or error signal appears between the base and emitter of transistor Q14. The base tends to become more positive and the collector current of Q14 is reduced, which results in a decrease of voltage across R26. This lowers the base-emitter voltage of Q13 and increases the impedance of Q13. The increased impedance of Q13 then reduces the voltage drop across R23, which increases the forward bias of transistor Q12. The impedance of Q12 is reduced and raises the base voltage of Q11. The forward bias of Q11 is reduced and Q11 impedance increases. As a result, the passing stage's impedance increases and absorbs the extra voltage. The output voltage remains at the preset value.

Figure # 10



5. Current Limiting Circuit

The current limiting circuit is a safety feature incorporated to protect the load against excessive currents. Refer to Figure # 11

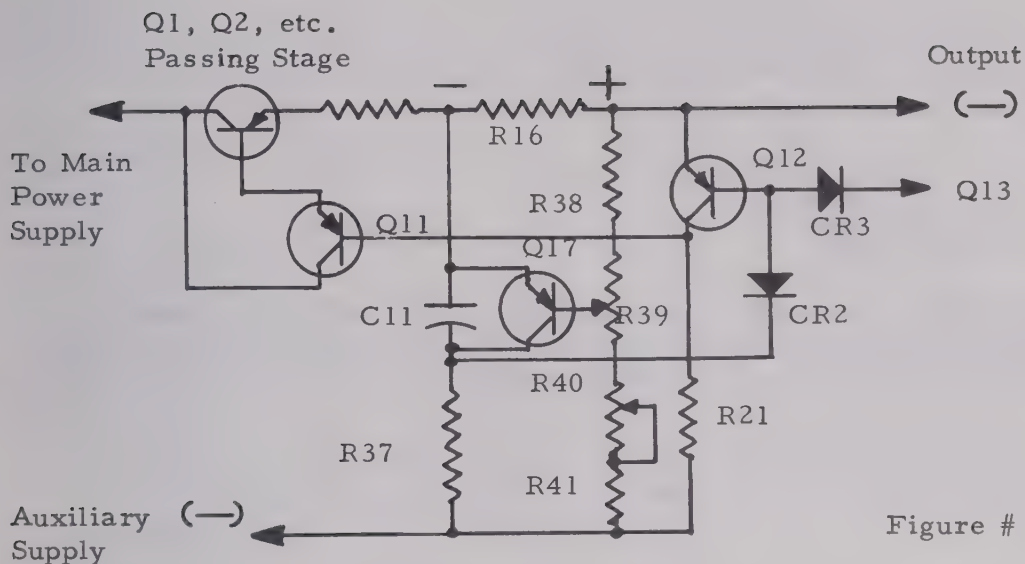


Figure # 11

See Section V for the adjustment of current limiting control. Resistor R39 determines the maximum current to be delivered to the load. Assume that an overload occurred at the load. The current would tend to rise. This rise would appear across R16, with a polarity indicated in Figure # 11. This would cause the impedance of transistor Q17 to increase, which in turn would cause the voltage drop across R37 to decrease. This would cause diode CR2 and transistor Q12 to conduct. As a result, the forward bias of transistor Q11 would be reduced increasing the impedance of Q11 and the passing stage transistors. This would reduce the output voltage and the short circuit current to the preset value.

V. MAINTENANCE AND REPAIR

During normal life this instrument requires no maintenance other than the care afforded similar equipment. It is suggested that excessive dust and any other foreign matter be removed periodically, exercising care to prevent damage to the instrument by cleaning tools or excessively strong air blasts.

CAUTION: KEEP ALL LINKS TIGHT AT ALL TIMES

A. Trouble Shooting

Only qualified personnel understanding transistorized regulator circuitry should attempt the repair of this unit, if damage should occur. Major servicing should be done only by the factory or one of its representatives.

Symptom	Probable Cause	Solution
1. No output Voltage	1. a. Blown input fuse b. Defective switch (S1)	Replace switch
2. High output	2. a. Shorted passing stage	Check for defective transistor
3. Poor regulation	3. a. Defective transistor in control amplifier b. Defective CR5 c. Check voltage across R36, it should be approximately 20 V d. Defective CR8	Check Q11, 12, 13, 14 and 15 Replace If not correct, readjust R34 Replace
4. No current limiting	4. a. Defective resistors R38, 39, 40, 41 b. Defective transistor Q17 c. Check link (Current) d. Defective CR2, CR3	Replace Replace Adjust Replace
5. High output ripple	5. a. Defective control amplifier. Check transistors & components b. Defective filter capacitor	Replace as required Replace as required

B. Adjustment Procedure

1. Bias Supply Adjustment

Apply input voltage to the unit. Place a DC voltmeter across resistor R36. Adjust resistor R34 to produce a 20 volt $\pm$ 2% reading across R36.

2. Output Range Adjustment

- a. Set output volt adjust (front panel control) completely clockwise.
- b. Adjust potentiometer R30 (located at the rear of the unit) for a reading at the output terminals of full rated output voltage. The output is now calibrated at 100 ohms per volt.
- c. Turn the output adjust potentiometer R4 counter clockwise and note that the output voltage goes approximately 0.15 volts negative.

3. Current Limiting Range Adjustment

- a. Set potentiometer R38 and R40 (rear panel controls) to their midway settings.
- b. Set " CUR LIMIT AMPS" potentiometer R39 (front panel control) fully clockwise.
- c. Turn unit on and set output to full rated output voltage.
- d. Apply a resistive load of approximately 120% of the rated load. Example 1.8 amps for a 1.5 amp unit.
- e. Set " CUR LIMIT AMPS" control completely counter clockwise and adjust R38 to minimum current limit (see specifications page 3).
- f. With " CUR LIMIT AMPS" control fully clockwise, adjust R40 to produce a reading of the maximum current limit (see specifications page 3).
- g. Repeat steps 5 and 6 until both extremes of the range are adjusted.
- h. Current limiting may now be set to any value between minimum and maximum by use of the " CUR LIMIT AMPS" control (front panel).

REPLACEMENT PARTS LIST

LIST NO. A14-4714 C

MODEL ORB 40-.75

SHEET 1 OF 4

SERIAL NO. TO

SCHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
C		Capacitor, 900 MFD., 75 VDC + 100, - 10%	Main Supply Filter	24-2513	AEROVOX AEF
C2		Capacitor, 20 Mfd. 100 VDC, +150%, - 10%	Ripple Bypass Capacitor	24-2203	Cornell Dubilier #NLW357
C3		Capacitor, 900 MFD., 75 VDC + 100, - 10%	Output Filter Capacitor	24-2513	AEROVOX AEF
C4		Capacitor, .022 Mfd. 200 VDC, $\pm 20\%$	Stabilizing Circuit Capacitor	24-2409-9	AEROVOX TYPE V146XR
C5, C6		Capacitor, .1 Mfd. 100 VDC, $\pm 10\%$	Stabilizing Circuit Capacitor	24-2401	Cornell Dubilier #WMF1P1E
C7		Capacitor, .047 Mfd. 100 VDC, $\pm 10\%$	Stabilizing Circuit Capacitor	24-2402	Cornell Dubilier #WMF1S47E
C8		Capacitor, .1 Mfd. 400 VDC, $\pm 20\%$	Ripple Suppression Capacitor	24-2411-13	Aerovox Type V146XR
C9		Capacitor, 150 Mfd. 100 VDC	Auxiliary Supply Filter	24-2205	Cornell Dubilier #BREX10773
C10		Capacitor, 40 Mfd. 50VDC +150%, - 10%	Reference Filter Capacitor	24-2207	Cornell Dubilier #NLP345
C11		Capacitor, .22 Mfd, 100 VDC, $\pm 10\%$	Current Stabilization	24-2403	Cornell Dubilier #WMF1P22E
C12		Capacitor, 20 MFD., 100 VDC $\pm 150\%$	Oscillation Suppressor	24-2203	Cornell Dubilier #NLW357
CR1A, B, C, D	4	Rectifier, Silicon, 1N1219	Main Power Supply Rectifier	26-107	Westinghouse #320-C
CR2	1	Rectifier, Silicon, 1N2482	Blocking Rectifier	26-887	Sarkes Tarzian Type F-2
CR3	1	Rectifier, Silicon, 1N2482	Blocking Rectifier	26-887	Sarkes Tarzian Type F-2
CR4	1	Rectifier, Silicon, 1N2482	Surge Suppression	26-887	Sarkes Tarzian Type F-2
CR5	1	Rectifier, Zener, 3/4 Watt, (1N2621)	Reference Diode	26-202	Dickson Electronics Type 3/4 T5OA9.3
CR6A, B	2	Rectifier, 1N2483	Auxiliary Supply Rectifier	26-894	Sarkes Tarzian Type F-4
CR7	1	Rectifier, Silicon, 2A50	Constant Current Circuit	⑤ 26-1002-3	Solitron Type 2A50
CR8	1	Rectifier, Zener, 10 Watt, (1N2988A)	Pre-Regulator Diode	26-201	Dickson Electronics #10227D10
CR9	1	Rectifier, Germ. Diode, (1N2326)	Compensation Diode	26-108	RCA Type 1N2326
DS1	3	Pilot Lamp, Red	Power "ON" Indicator	43-308	Industrial Group 1V-B

REPLACEMENT PARTS LIST

MODEL QRB 40-.75SERIAL NO. 1000 TO LIST NO. A14- 4714 DSHEET 2 OF 4

SCHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
F1	5	Fuse, 1 Amp 250V, 3AG Fuse Holder, 3AG	Input Fuse	42-2800 42-459	Littlefuse #314001 Littlefuse #342012
M1		Meter,	Voltmeter & Ammeter	94-393-2	Ammon AM-2
Q1 thru Q4	4	Transistor	Passing Transistor	②③① 18-154	Sorensen - A UNIT OF RAYTHEON
Q11	1	Transistor	Driver Amplifier	④ 18-059	Clevite #CTP 1735
Q12	1	Transistor, NPN	Amplifier	18-089	Texas Instr. Inc. 2N1303
Q13	1	Transistor NPN	Amplifier	18-092	Texas Instr. Inc. 2N1302
Q14	1	Transistor, PNP	Input Amplifier	18-075	Motorola 2N1193
Q15	1	Transistor, PNP	Constant Current Reference Amplifier	18-076	RCA 2N270
Q16	1	Transistor	Constant Current Pwr. Amp	④ 18-059	Clevite #CTP1735
Q17	1	Transistor, PNP	Current Limiter Amplifier	18-076	RCA 2N270
R1		Resistor, 50 $\sim$ 3W $\pm$ 5%	Main Supply Bleeder	28-866	W.L. 3X50
R2		Resistor, .2 Ω , 2W, $\pm$ 1%	Ammeter Shunt Resistor	28-898	Sage Electric #SA2W
R3		Resistor, 100 Ω , 1/2W, $\pm$ 1%	Voltage Divider	28-896	IRC Type DCC
R4		Pot 4000 $\sim$ 40 $\sim$, 2W $\pm$ 5%	Output Volt Adjust, Dual	29-404	CLAROSTAT #43 SERIES
R5		Resistor 49.9 K $\sim$ 1/2W	Meter Multiplier	28-897	IRC TYPE DCC
R6 thru R9		Resistor, 5 Ω , 3W, $\pm$ 5%	Passing Stage Balance	28-865	Ward Leonard 3X-5
R16		Resistor, 0.4 Ω , 2W, $\pm$ 5%	Current Limiting Sensing	28-1009	Sage SA2W. 4-5
R17		Resistor 700 $\sim$ 3W	Power Amplifier Bias	28-822	W.L. QZTC 700
R18		Resistor 3.9K $\sim$ 1/2W $\pm$ 10%	Q11 Reverse Bias	27-186	OHMITE
R19		Resistor, 15K Ω , 1/2W, $\pm$ 10%	Amplifier Base Compensation	27-179	Allen Bradley #EB1531
R20		Resistor, 150 Ω , 1/2W, $\pm$ 10%	Stabilizing Circuit	27-183	Allen Bradley #EB1511
R21		Resistor, 1K Ω , 2W, $\pm$ 10%	Q12 Collector Resistor	27-302	Allen Bradley #HB1021
R22		Resistor, 100 Ω , 1/2W, $\pm$ 10%	Stabilizing Circuit	27-173	Allen Bradley #EB1011
R23		Resistor, 6.8K Ω , 1/2W, $\pm$ 10%	Q13 Emitter Resistor	27-185	Allen Bradley #EB36821
R24		Resistor, 100 Ω , 1/2W, $\pm$ 10%	Stabilizing Circuit	27-173	Allen Bradley #EB1011

REPLACEMENT PARTS LIST

LIST NO. A14-4714 D

SHEET 3 OF 4

MODEL ORB 40-.75SERIAL NO. 100 TO

SCHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
R25		Resistor, 1K Ω , 1/2W, $\pm 10\%$	Voltage Divider	27-103	Allen Bradley #EB1021
R26		Resistor, 15K Ω , 1/2W $\pm 10\%$	Voltage Divider	27-179	Allen Bradley #EB1531
R27		Resistor, 560 Ω , 1/2W, $\pm 10\%$	Q14 Base Resistor	27-1103	Allen Bradley #EB5611
R28		Resistor, 430 Ω , 1/2W, $\pm 5\%$	Temp. Compensation Shunt	27-1104	Allen Bradley #EB4315
R29		Resistor, 270 Ω , 12W, $\pm 5\%$	Temp. Compensation	28-1000	Int. Resistance Type 1-3/4A
R30		Potentiometer, 2K Ω , 2W, $\pm 10\%$	Output Range Adjust	29-358	Clarostat 43T Series
R31		Resistor, 1K Ω , 1/2W, $\pm 10\%$	Q15 Collector Resistor	27-103	Allen Bradley #EB1021
R32		Resistor, 1.8K Ω , 1/2W $\pm 10\%$	Reference Bridge Resistor	27-176	Allen Bradley #EB1821
R33		Resistor, 750 Ω , 10W, $\pm 5\%$	Reference Bleeder	27-544	Ward Leonard #10F750
R34		Potentiometer, 5 Ω , 2W, $\pm 20\%$	Constant Current Adjust	29-346	C. T. C. Corp. SERIES 110
R35		Resistor, 6.8K Ω , 2W, $\pm 5\%$	Q16 Base Resistor	27-352	Allen Bradley #HB6825
R36		Resistor, 150 Ω , 10W, $\pm 5\%$	Reverse Bias	27-517	Ward Leonard #10F150
R37		Resistor, 10K Ω , 1/2W $\pm 10\%$	Q17 Collector Resistor	27-133	Allen Bradley #1031
R38		Potentiometer, 500 Ω , 2W $\pm 10\%$	Lower Limit Current Adjust	29-330	Mallory & Co. Type R
R39		Potentiometer, 500 Ω , 2W $\pm 10\%$	Current Limiting Adjust	29-329	Mallory & Co. Type R
R40		Potentiometer, 25K Ω 2W $\pm 10\%$	Upper Limit Current Adjust	29-328	Mallory & Co. Type R
R41		Resistor, 27K Ω , 1/2W, $\pm 10\%$	Current Limiter	27-110	Allen Bradley #EB2731
S1		Switch, Rotary, 3 Pos., 2 Sect.	On-Off & Meter Switch	45-248	Mallory #RS60-2
T1		Transformer	Power Transformer	126-2464	Sorensen A UNIT OF RAYTHEON

REVISION SHEET
REPLACEMENT PARTS LIST
MODEL QRB 40-.75
SERIAL NO. TO

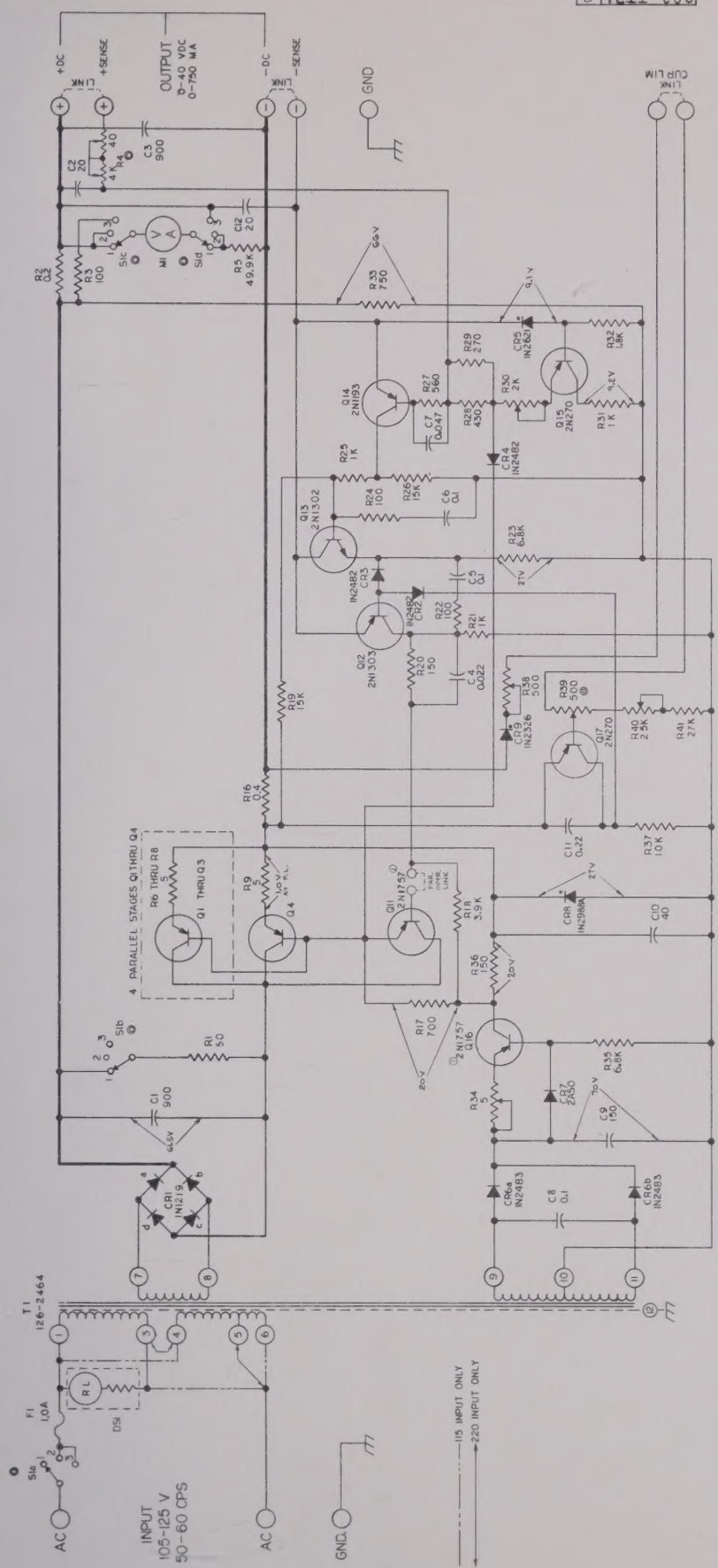
LIST NO. A14-4714
SHEET 4 OF 4

SCHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
A	1	TRANS 18-053 WAS 18-055	EN 2-2000	FP	627-60
B	1	18-118 WAS 18-084 EN 2-2000			
C	3	18-154 WAS 18-112 EN 2-3710 EFFECTIVE SERIAL # 1045		MF	
D	4	18-059 WAS 18-060		MF	
	5	CR7 WAS 26-864 EN 2-3746 EFFECTIVE SERIAL # 1045		MF	5366

FOR REFERENCE
SCHEMATIC DRAWING
D 200- 3324

SORENSEN-A UNIT OF RAYTHEON CO.
RICHARDS AVENUE, SO. NORWALK, CONN.

LIST NO. A14-4714 D
SHEET OF
PREPARED DATE
APPROVED BY



NOTE:

1. 0 PANEL CONTROL
2. ALL RESISTANCE IN OHMS UNLESS OTHERWISE NOTED
3. ALL CAPACITANCE VALUES IN MFD UNLESS OTHERWISE NOTED
4. SWITCH POSITIONS FOR SI POS. 2 ON AND VOLTMETER POS. 3 ON AND AMMETER
5. ALL VOLTAGE READINGS TAKEN AT NO LOAD UNLESS OTHERWISE INDICATED. CURRENT READINGS TAKEN WITH A 2000 OHM METER (VOLTAGE READING 2.0V)

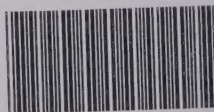
SERIAL NO. 100 TO

RELEASED

DRAWING APPROVED AND AUTHORIZED		TOLERANCES ARE IN PARENTHESES	
DESIGNED BY		CHECKED BY	
DRAWN BY		DATE	
MATERIAL		FINISH	
PARTS LIST		TEST INSTRUCTIONS	
SCHEMATIC		QRB 40-75	
D 1200-3324 B			

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